Appendix B – Construction and Maintenance Activities

1.0 Construction Procedures

In order to construct the proposed project, BPA would follow existing construction practices for building the transmission line and substation. The following general steps would be followed:

- Right of Way (ROW) acquisition and preparation;
- Access road construction or improvement;
- Structure site preparation;
- Structure construction and erection;
- Insulator installation and conductor and ground wire stringing; and
- Site restoration and cleanup.

1.1. Right-of-Way Acquisition and Preparation

New ROW would be needed for the new structures and line. The new ROW would be 150 ft wide. In Segment D where BPA proposes to build a double-circuit line, the existing ROW would be expanded 25 ft on either side of the existing 100 ft wide ROW, to increase the ROW to 150 ft.

BPA would obtain easements from landowners for new ROW. These easements give the BPA the right to construct, operate, and maintain the line and access roads. Fee title to the land covered by the easement generally remains with the owner, and is subject to the provisions of the easement.

The easement prohibits large structures, tall trees, storing flammable materials and other activities that could be hazardous to people or endanger the transmission line. Activities that do not interfere with the transmission line or endanger people are usually not restricted.

Vegetation within a ROW is restricted by height. This is required for the safe and uninterrupted operation of the line. It is not anticipated that a large number of trees will need to be cleared for this project, however because of safety considerations there may be some trees at water crossings that would need to be cut.

The amount of vegetation to be removed is based on a clearing advisory (which describes safe vegetation heights along and at varying distances from the centerline) and local knowledge regarding regional conditions such as weather patterns, storm frequency and severity, general tree health, and soils. Considerations that would also influence the amount of clearing along the line are: line voltage, vegetation species, height and growth rates, ground slope, conductor elevation above ground, and the clearance distance required between the conductors and other objects.

Woody debris and other vegetation would either be left lopped and scattered, piled, or chipped, or would be taken off-site. Burning may or may not be used, due to *air shed* constraints. Contractors would be required to use brush blades instead of dirt blades on bulldozers for clearing. Other specialized brushing/mulching equipment may be required.

At the structure sites, all trees, brush, and stumps over 22 in and *snags* would be felled and removed, including root systems. The site would be graded to provide a relatively level work surface. The total amount of clearing required is unknown at this time.

An additional amount of vegetation would be cleared for access roads that are needed off the ROW and for roads in poor condition that BPA would upgrade. Roads are discussed in the next section.

1.2 Access Road System

BPA would acquire access rights to develop and maintain permanent ground access for wheeled vehicle travel to each structure. Access roads are designed for use by cranes, excavators, supply trucks, boom trucks, and line trucks for construction and maintenance of transmission lines. Truck size and carrying weight help determine road specifications.

An access road system on and off the ROW would be used to construct and maintain a new line. New roads would be within the ROW wherever possible, but where conditions require, roads would be constructed and used outside the ROW. When the new line would be 1,200 ft from the existing line, a new road system would be built. Where the new line would be built directly adjacent to an existing line, the existing access road system would be used, with spur roads to the new towers. No permanent access road construction would be constructed in cultivated or fallow fields. Any temporary access roads in cropland would be removed and the ground would be restored to its original contour when the line is completed.

A 50 ft. ROW would be acquired for new road access and 20 ft. of ROW would be acquired for any existing access roads. New access roads would be 16 ft. wide, with additional road widths of up to 25 ft. for curves. Roads would be dirt, gravel, or rock. BPA prefers to have road grades of 6 percent or less for highly erodible soils (silts) and 10 percent for soils that are more erosion resistant (earth and broken rock). For short distances, maximum acceptable road gradients are 15 percent for trunk or main roads, and 18 percent for spur roads.

BPA improves access roads by grading, improving drainage, and adding gravel to the road surface. After construction, roads are maintained for emergency access and maintenance. In some areas where access roads would not be built, helicopter construction would be used to erect structures and put up conductors.

Dips, culverts, and *waterbars* would be installed within the roadbed to provide drainage. If the road is to be temporary, any disturbed ground would be repaired and if the land use permits, the road would be reseeded with grass or other appropriate seed mixtures. After the line is built, access roads would also be used for line maintenance. If the ground is disturbed by maintenance activities, the roadbed would be repaired and reseeded if necessary. Fences, gates, cattle guards and additional rock would be added to access roads where necessary

For each segment, the following table shows the miles of estimated new access roads and existing roads that would need to be improved. Assumptions were made based on terrain and line location.

Table 2.3-1
Estimate of Access Road Development (Length)

Segment	Length (mi)	New Construction (road mi/ segment mi)	Total New Construction (mi)	Improvement (road mi/ segment mi)	Total Improvement (mi)
A	29.4	1.6	47.0	0.8	23.5
Bn	9.5	1.7	16.2	1.5	14.3
Bs	10.4	1.7	17.7	1.5	15.6
C	29.8	2.8	83.4	2.5	74.5
D	27.3	0	0	1.3	35.5
E	23.2	1.3	30.2	2	46.4
F	32.1	1.5	48.2	1	32.1

Table 2.3-2
Estimate of Access Road Disturbance (Area)

Segment	Existing Road Disturbance Width (ft)	New Road Disturbance Width (ft)	New Road (Ac)	Improved Roads (Ac)	Road Work (Ac)
A	16	25	142.4	45.6	188.0
Bn	16	25	49.1	27.7	76.8
Bs	16	25	53.6	30.3	83.9
C	16	25	252.7	144.5	397.2
D	16	25	0	68.8	68.8
E	16	25	91.5	90.0	181.5
F	16	25	146.1	62.3	208.4

1.3 Construction

1.3.1 Storage, Assembly, and Re-fueling Areas

Construction contractors would establish storage areas near the transmission line to stockpile materials for structures, spools of conductor and other construction materials until the material is needed. These areas are selected to be accessible from major roads or highways. Steel for structures is delivered in pieces on flatbed trucks and needs to be assembled on-site. A mobile crane may be needed to handle the bundles. If the terrain is too steep at the actual structure site, general assembly yards are used to erect the tower in pieces after which they are transported to the structure site by truck or helicopter. Because trucks and helicopters need to refuel often, these areas can also be used for re-fueling.

1.3.2 Structures

Transmission line structures are usually constructed using ground methods. The equipment used depends on the weight and size of the towers, and site conditions such as weather and soil characteristics. Most 500-kV lines are built using mobile cranes, but helicopter tower erection can be used as mitigation if access is unavailable or if sensitive resources must be protected. Single-circuit steel lattice towers would be used to support the transmission line conductors. The height of each structure would vary by location and surrounding landforms. Structures would average 135 ft high. The double-circuit towers would be lattice steel and approx. 170 ft high.

Most structures that would be used on the proposed line would be suspension structures. Other structures, called deadend structures, would be used where the transmission line changes direction, has an excessively long span, crosses extremely steep or rugged terrain, or crosses highways or rivers. Deadend structures equalize stresses on the conductors in these situations and are made of heavier gauge steel.

All vegetation would be removed from structure sites. Sites would be graded, if needed, to provide a level work area. An average area of about 100 ft by 100 ft would be disturbed at each structure site.

Steel towers are anchored to the ground by footings. These towers require four footings, which are placed into holes that have been excavated or blasted. Large machinery, such as backhoes or truck-mounted augurs, is used to excavate footings. The design of footings varies in response to such factors as soil properties, bedrock depth, and the soundness of the bedrock encountered. Typically, towers are attached to steel plates or grillages that are placed within the excavated area. The area is then backfilled with excavated material. If BPA finds a footing to be unstable, concrete may be used to backfill the footing. Topsoil is stockpiled during excavation and replaced during backfilling to restore the original ground surface.

Footings for suspension towers generally occupy an area of about 6 ft by 6 ft, to a depth of 12 ft. Deadend structures would have larger, deeper footings. Their footprint would be about 15 ft by 15 ft and 16 ft deep. The footings for double circuit suspension towers occupy an area of about 8 ft by 8 ft, to a depth of 12 ft. Deadend double circuit towers would have footing that are approximately 18 ft by 18 ft and 19 ft deep. These depths would be used if bedrock is not found. If bedrock is found and if the rock has properties that allow anchor borings, holes would be drilled in the rock and steel rods would be grouted within the rock. These rods are attached to either a concrete footing or welded directly to a tower member and embedded in compacted backfill. If rock properties are not suitable for anchor rods, the rock may be blasted to obtain adequate footing depth.

Steel towers are assembled in sections near the tower site. Each tower contains three components: the tower legs, the tower body, and the bridge. The bridge is the uppermost portion of the tower and serves as the attachment point for the insulators, which in turn support the conductors.

As the towers are built, heavy machinery will disturb the ground surface and/or compact soils in the tower site area and along access roads. Machinery will generate noise and dust.

1.3.3 Conductors

The wires or lines that carry the electrical current in a transmission line are called conductors. Alternating current transmission lines, like the proposed line, require three wires or sets of wires, each of which is referred to as a "phase." Each conductor would be about 1.30 inches in diameter. There would be 3 conductors per bundle, which would be about 20 inches across. Conductors are not covered with insulating material, but rather use the air for insulation. Conductors are physically separated on the transmission structure.

After transmission structures are in place, workers first attach a smaller steel cable that is attached to the conductor to the structures, then pull the conductor under tension through the structures. Conductors are attached to the structure using glass, porcelain or fiberglass insulators. Insulators prevent the electricity in the conductors from moving to other conductors, the structure and the ground. As the lines are strung, the ground surface will be disturbed at the tensioning sites (approximately one acre per tensioning site every 2.5 miles), and noise and dust will be generated by machinery.

Transmission structures elevate conductors to provide safety within the ROW for people and structures. The National Electrical Safety Code establishes minimum conductor heights. Minimum conductor-to-ground clearance for a 500-kV line is 30 ft. Greater clearance would be provided over highway, railroad, and river crossings.

One or two smaller wires, called overhead ground wires, are attached to the top of transmission structures. Overhead ground wires protect the transmission line from lightning damage. The width of the wire varies from 0.375 to 0.625 in. Fiber optic cable may be attached to the tower as well.

1.3.3 Site Restoration and Clean-up

After the structures are in place and conductors are strung between the structures, BPA would restore disturbed areas. Soil around the tower, conductor reel, and pull site locations would be reshaped and contoured to a condition consistent with its original condition. Disturbed areas would be reseeded with grass or an appropriate seed mixture to prevent erosion. All litter and other remaining materials from construction would be disposed of, and equipment would be removed from the ROW.

1.4 Wautoma Substation Construction

A new substation would be constructed at the proposed Wautoma Substation site. The footprint of the substation would be approximately (850 ft x 500 ft). This area would include the substation yard (equipment within the fence) and grading outside of the fence.

Equipment inside the substation yard would include: breakers, switches, capacitors, buswork, substation deadends, a control house and possible transformers. No vegetation is allowed to grow within the fenced substation yard.

In order to build a new substation, construction crews would first clear and grade the substation site. Conduits, drainage pipes, and the grounding system would be trenched or dug into the ground. Footings for the equipment and foundation for the control house would be placed in appropriate positions. A chain link fence around the substation would be installed. About six inches of rock would be laid, which would extend outside of the fence. Equipment such as breakers, buswork, switches and PT's would be installed in the yard, and the control rack would be installed in the control house.